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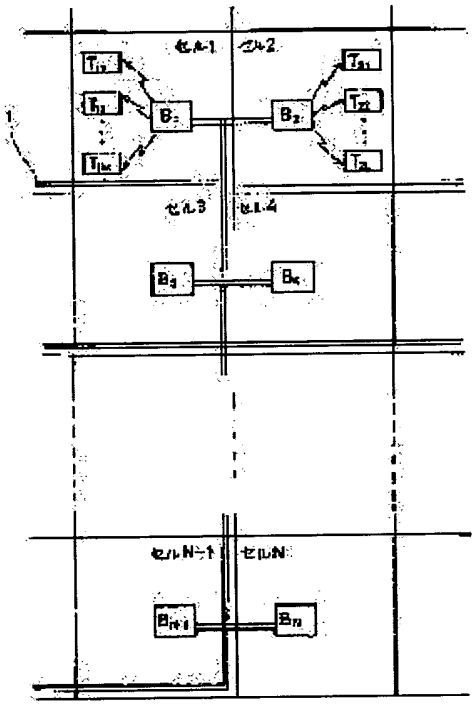
(54) SPREAD SPECTRUM COMMUNICATION SYSTEM

(57)Abstract:

PURPOSE: To obtain the network system in which stable communication is attained without causing collision among plural base stations by allowing all base stations and terminal stations to use the same hopping pattern.

CONSTITUTION: Suppose that the slot number of hopped frequencies is N slots, an area desired to form a network is divided into N-sets of areas or below. When the number of cells being one unit of the divided area is N, and each of the cells 1-N is allocated with one of base stations B1-BN and plural terminal stations T1-T1M and T21-T2L connecting to the base stations B1-BN, for example, the terminal stations T1-T1M are arranged in the base station B1 and the base stations B1-BN and the terminal stations T1-T1M and T21-T2L are connected by using the low speed frequency hopping spread spectrum communication system. In this case, all the base stations B1-BN are in-wire connection by using a cable 1 and synchronization is taken so that the frequency hopping timing is the same for all the base stations B1-BN.



LEGAL STATUS

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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] It consists of one or more terminal offices connected to two or more base station and each base station by low-speed frequency-hopping spread-spectrum communication. All base stations and terminal offices have the same hopping pattern, and connect with a cable and two or more base stations synchronize the timing of frequency hopping in each base station. The spread-spectrum communication mode characterized by using it, delaying the hopping pattern of each base station for every hopping timing which was able to be defined beforehand so that the frequency used in the slot of the same hopping timing in each base station may not become the same.
[Claim 2] The spread-spectrum communication mode according to claim 1 characterized by the thing which were able to define the transmit data beforehand, and which it frame-izes for every number of bits, and base station information is added in this frame, and is done for frequency hopping for every frame.
[Claim 3] The spread-spectrum communication mode according to claim 1 characterized by the thing which were able to define the transmit data beforehand, and which it frame-izes for every number of bits, and a hour entry is added in this frame, and is done for frequency hopping for every frame.
[Claim 4] Make one base station in two or more base stations into a control station, and a test signal is transmitted to the during starting of a system from a control station to each base station. By measuring time after transmitting the reply signal to a test signal to a control station immediately after reception of a test signal in each base station and transmitting a test signal in a control station until it receives a reply signal The spread-spectrum communication mode according to claim 1 characterized by obtaining the amount of propagation delay time from a control station to each base station, and performing amendment to the propagation delay time of the hopping timing signal from a control station with the amount of propagation delay time.
[Claim 5] In each base station, two or more transmitter-receivers for frequency-hopping spread-spectrum communication are held. By setting the amount of delay of a respectively different hopping pattern to each transmitter-receiver, and operating two or more receivers according to this amount of delay The spread-spectrum communication mode according to claim 1 which will be characterized by performing a broadcast with two or more terminal offices using the amount of delay if the monitor of the operating condition of the frequency in other cells is carried out and the amount of delay of the hopping pattern which is not used exists.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to improvement of the spread-spectrum communication mode by frequency hopping.
[0002]
[Description of the Prior Art] A spread-spectrum communication mode is a communication mode which diffuses and transmits a signal to a wide band, and excels the bandwidth of an information signal in disturbance-proof nature and unknown episode nature, and various application is considered taking advantage of the features, like it is still stronger to phasing. The communication mode which used frequency hopping in a spread-spectrum communication mode for below is explained.
[0003] Drawing 6 (a) and (b) are the block diagrams of an example of the conventional transmitter in frequency-hopping spread-spectrum communication, and a receiver, respectively.
[0004] In drawing 6 (a), transmit data 13 becomes the modulating signal 15 in IF frequency band by the modulator 14. A modulating signal 15 is changed into RF frequency by the frequency converter 16. The local oscillation frequency 17 from a frequency synthesizer 31 supplied to a frequency converter 16 is switched according to the hopping pattern which is generated by the hopping pattern generator 30 and which was defined beforehand in that case. Thereby, by generating the spread-spectrum signal 18 and letting it pass to a band pass filter (BPF) 19, the spread-spectrum sending signal 20 is generated and it is transmitted from an antenna 32.
[0005] In drawing 6 (b), the spread-spectrum input signal 21 received with the antenna 33 is changed into IF frequency from RF frequency by the frequency converter 24 after passing a band pass filter (BPF) 22. In that case, the local oscillation frequency 25 from the frequency synthesizer 35 supplied to a frequency converter 24 is the same hopping pattern as the transmitting side generated in the hopping pattern generator 34, and is switched synchronizing with the hopping timing of the spread-spectrum input signal 21. Thereby, the spread-spectrum signal 23 of a wide band is changed into the original modulating signal 26 of a narrow-band with fixed IF frequency, and data restore to it by the demodulator 27. At this time, a part of modulating signal 26 is supplied to initial synchronous acquisition and the trace circuit 36, and it performs initial synchronous acquisition and the synchronous trace after it. The spread-spectrum signal 23 can also be used for an initial synchronization and a trace.
[0006] Frequency hopping is indicated in detail by Mitsuo Yokoyama work "spread-spectrum communication system" p563-p611 of technology publishing company issue.
[0007] When it constitutes a network from two or more base stations and one or more terminal offices, the hopping pattern of the frequency of the signal transmitted in each base station is an individual pattern respectively, and is communicating to separate timing also about hopping timing. The same hopping pattern is used in the terminal office connected to one base station.
[0008]
[Problem(s) to be Solved by the Invention] Although it is diffused in the wide band in prolonged observation, when the spectrum distribution in frequency-hopping spectrum spread system is observed for a short time (for example, 1-bit unit), it is a narrow-band signal which makes only a private use of a specific frequency band. So, in order to use the same frequency band in two or more base stations depending on a hopping pattern and hopping timing, a collision takes place. For example, an error rate will be set to 10-2 if it collides with the frequency band for which the base station of others [one / of frequency bands of it] uses the data transmitted by one frequency band even if it transmits using 100 frequency bands.
[0009] The purpose of this invention is in the communication which used the frequency-hopping spread spectrum to offer the network system in which the stable communication is possible, without causing the collision between two or

more base stations.
[0010]
[Means for Solving the Problem] in the spread-spectrum communication mode of this invention, the hopping pattern was able to be beforehand defined so that each base station and the terminal office which belongs to it might be connected by low-speed frequency-hopping spread-spectrum communication, respectively, between two or more base stations might be connected with a cable, the hopping timing of the frequency between all the base stations in a network might be synchronized and the frequency used among two or more base stations to the same timing might not lap -- you make it delayed hopping timing every, and it uses
[0011]
[Function] Since this inventions are the above composition, they enable communication which moreover does not have the collision of the frequency between two or more base stations in all base stations and terminal offices using the same hopping pattern.
[0012]
[Example] Drawing 1 is the block diagram of one example of the network system of this invention. When the number of slots of the frequency which carries out hopping is used as N slot, the area which wants to constitute a network is divided into N or less area. Hereafter, one unit of the divided area is called cell. When the number of cells is N, in each cell of a cell 1 - Cell N, it is one base station B1 -BN, respectively. Arranging terminal office T1 -T1M to two or more terminal offices B1 linked to the base station, for example, a base station, a base station and a terminal office connect using a low-speed frequency-hopping spread-spectrum communication mode. Cable connection is made by the cable 1 between all base stations, and it synchronizes so that the hopping timing of frequency may become the same in all base stations. Moreover, the hopping pattern of frequency gives the same pattern in all base stations and terminal offices, and it delays the hopping timing [every] pattern defined beforehand to the same timing so that the slot which two or more base stations use may not overlap.
[0013] The synchronous process of the hopping timing between the base stations at this time is explained below. One game set to arbitration among two or more base stations is made into the control station of a synchronization, and the synchronizing signal of hopping timing is transmitted to each base station from a control station. In each base station, the synchronization of the hopping timing between base stations is performed by performing the hopping of frequency according to the synchronizing signal of the hopping timing from a control station.
[0014] Moreover, the frequency-hopping spread-spectrum communication mode connects, and at first, each base station and the terminal office belonging to it perform by turns transmission of the information which shows a connectable state with a terminal office, and the information on hopping timing, and receiving waiting of the information which shows the connection request from a terminal office in a base station while performing the hopping of frequency according to the hopping timing which synchronizes between base stations. In a terminal office, it stands by in the state of reception until a base station uses the slot of the frequency by the slot of the frequency defined beforehand, initial synchronous acquisition is performed by acquiring the information and the information on hopping timing which show the connectable state from a base station, and after that, by the synchronous flattery circuit, a synchronization is held and it communicates.
[0015] In the above system, time delay deltat second (s) arises from a control station in the synchronizing signal of the hopping timing between base stations according to the distance of the transmission line to a base station. Moreover, the hopping of the frequency of a base station and a terminal office is the time tA although carried out by switching frequency by the frequency synthesizer, after usually switching frequency to a frequency synthesizer until it is stabilized. There is (s) and it is tA at a transmitting side. The number of bits of the dummy data equivalent to the time more than (s) is set up beforehand, and is sent, and transmission of after [of frequency] stable and various information data is performed. In a receiving side, the number of bits of dummy data is disregarded and only various information data are recognized as recovery data.
[0016] Here, it is maximum time delay deltatmax of the synchronizing signal from a control station to a base station. Time tA until the frequency of (s) and a synthesizer is stabilized If (s) is compared deltatmax <<tA Time tA until it becomes and the frequency of a synthesizer is stabilized Since (s) becomes dominant to the number of bits of dummy data, Even if propagation-delay-time deltat (s) arises in the synchronizing signal of hopping timing, it can be considered that the synchronization of hopping timing is fully established.
[0017] Drawing 2 is a hopping timing chart in each base station. The synchronization of the hopping timing between each base station is established, and it is a base station B1. Hopping timing TH at the time of considering as a control station The slot allocation by the hopping pattern in each receiving base station is shown. A horizontal axis is Time t. Here, it is h1. Shell hN It is the number of a slot and the number of N is made to correspond by 1 to 1 from 1. As shown in this drawing, the base station of duplication of the slot in the same timing will be lost by N or less pieces, if

the synchronization between base stations is established.
[0018] Thus, stable communication can be performed, without causing the collision of the frequency between the adjoining base stations which were not avoided conventionally by using the network system using the frequency-hopping spread spectrum of this invention.
[0019] Next, the format of the data transmitted from each base station is explained. Drawing 3 is explanatory drawing of an example of the format. In communication of a base station and a terminal office, the transmit data in 1 hopping timing is made into B bit, and the frame for every B bit is formed. One frame consists of the dummy data 2, a preamble 3, base station information 4, and information data 5. Consequently, it is avoidable to connect with the cell which adjoins it accidentally since it is discriminable to the terminal office which is standing by in the state of reception by the slot defined beforehand at the time of initial synchronous acquisition, whether it is the information which which base station sent even if it receives the information which shows the connectable state from the adjoining cell, and.
[0020] Drawing 4 is explanatory drawing of other examples of a data format. In all base station and all terminal offices, it has the clock, respectively, and in communication of a base station and a terminal office, the transmit data in 1 hopping timing is made into B bit, and the frame for every B bit is formed. One frame consists of the dummy data 6, a preamble 7, a hour entry 8, and information data 9. Consequently, the relation of the slot and time which are used by connection of an eye at once is obtained in a terminal office. Therefore, first stage synchronous acquisition in a terminal office can be performed at high speed by changing the slot into which it can predict easily which slot a base station next uses in a terminal office when connecting again, once connection goes out, and a terminal office stands by in the state of reception according to the prediction.
[0021] The format of drawing 3 and the format of drawing 4 are also combinable. As mentioned above, with the cable length between a control station and a base station, since propagation delay time arises in the synchronizing signal of hopping timing, the gap has arisen to hopping timing correctly. as follows -- carrying out -- this gap -- an amendment -- things are made A test signal is transmitted to each base station from a control station, and each base station transmits a reply signal for reception of a test signal to system during starting immediately to a control station. At a control station, the amount of propagation delay time to each base station can be obtained from a control station by measuring time after transmitting a test signal until it receives a reply signal to each base station. thus, the thing to acquire for the amount of propagation delay time -- a gap of the hopping timing in each base station -- an amendment -- things are made and exact hopping timing can be synchronized in all base stations Moreover, even if the length of a cable changes with movements of a base station etc., a gap of the hopping timing by propagation delay time can be amended easily.
[0022] Drawing 5 is a block diagram of an example which performs a broadcast with two or more terminal offices which can be set in the same cell. As shown in this drawing, the transmitter and receiver for frequency-hopping spread-spectrum communication are considered as a transmitter-receiver block by one pair, and it is transmitter-receiver block C1 -CN of plurality [control block / of a base station / 40]. It connects. In control block 40, the control signal 12 of a change of transmission and reception of sending out of the hopping timing signal 10 to each transmitter-receiver block, processing of a transmitted and received data 11, and each transmitter-receiver block is sent out. For example, the number of slots of frequency is used as N slot, and it is the transmitter-receiver block C1 -CN same in each base station as the number of slots. Suppose that it is incorporated. It is made to operate like the system of the above-mentioned example using the first transmitter-receiver block 1 of each base station at this time. Transmitter-receiver block C1 Hopping timing synchronizes with the timing of a frequency-hopping pattern peculiar to the base station.
[0023] Transmitter-receiver block C2 Shell transmitter-receiver block CN It sets, the respectively same hopping pattern is delayed 1 hopping timing every, and it changes into the receiving state. thus, communication in the cell of others [carrying out] -- transmitter-receiver block C2 from -- transmitter-receiver block CN By receiving, the monitor of the state of communication of other cells can be carried out. Furthermore, transmitter-receiver block C2 Shell transmitter-receiver block CN If the transmitter-receiver block which is not used in inside exists, communication with a terminal office can be performed on the frequency of other slots using the transmitter-receiver block. By doing in this way, a broadcast with two or more terminal offices in the same cell which was not made and other cells is made possible by the system of the above-mentioned example.
[0024]
[Effect of the Invention] With the network system using low-speed frequency-hopping spread-spectrum communication of this invention, the same hopping pattern can be used in all the base stations and terminal offices in a network. And the network system in which the stable communication is possible can be realized, without causing the collision of the frequency between two or more base stations.

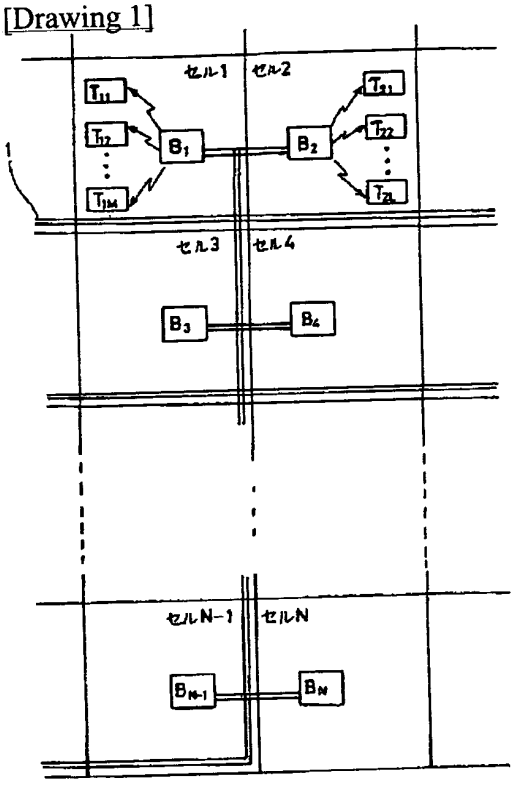
[Translation done.]

* NOTICES *

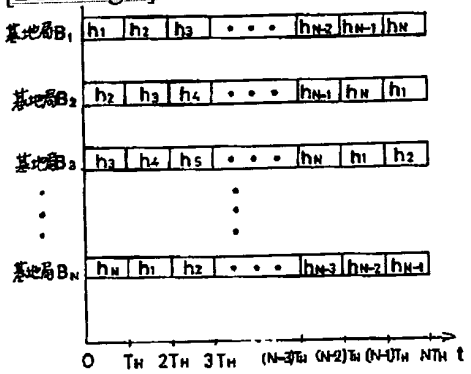
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

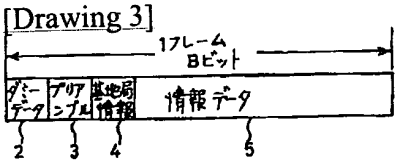
[Drawing 1]



[Drawing 2]



[Drawing 3]



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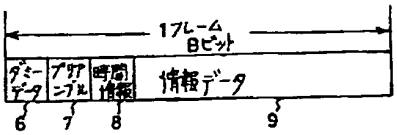
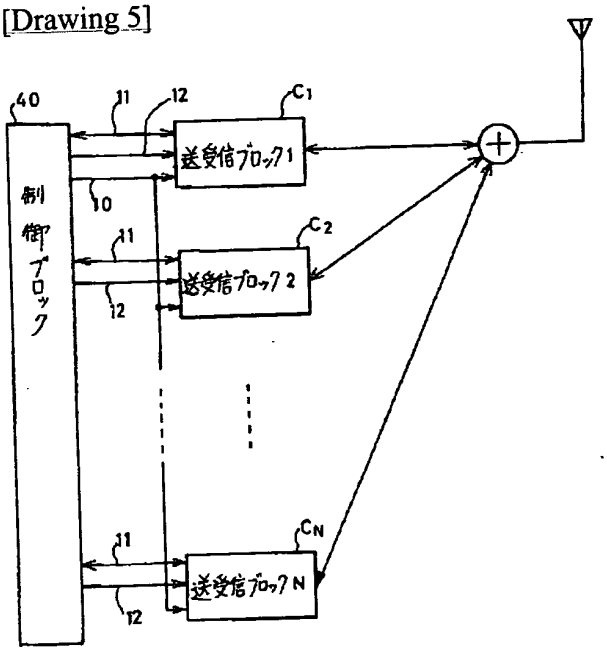
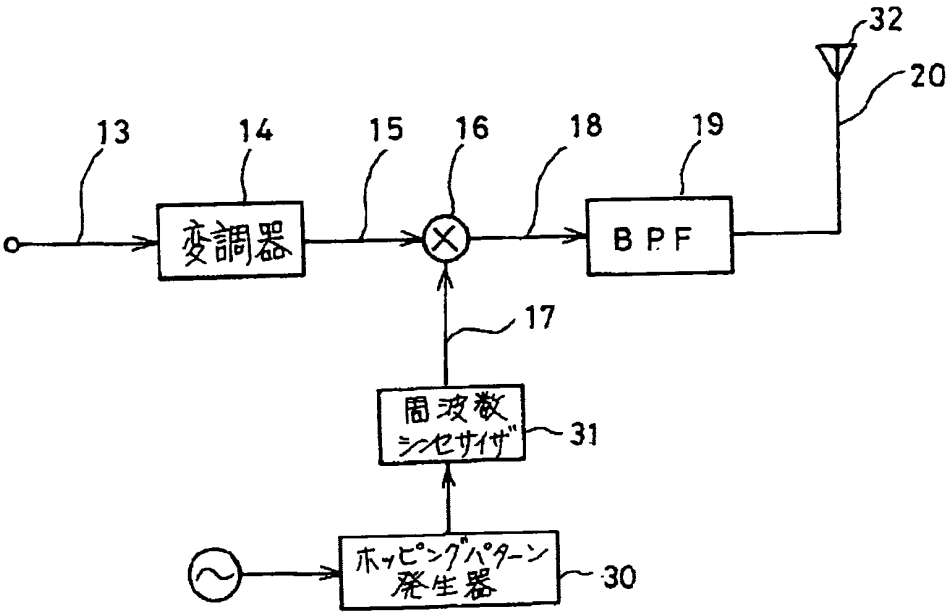


[Drawing 5]



[Drawing 6]



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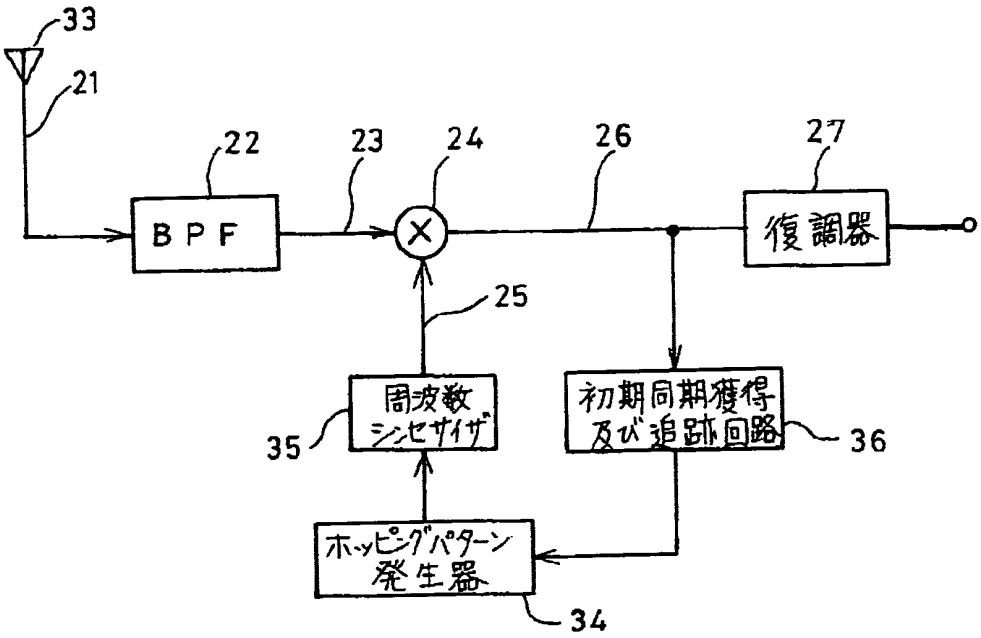

(b)

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